BRIEFING CHART

NASA SBIR/STTR Technologies
Thermal Management of Superconducting Electromagnets in VASIMR Thrusters
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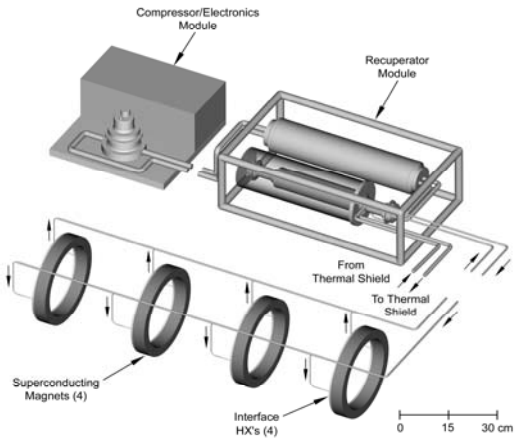
Proposal No.: 03-F7.01-8219

Identification and Significance of Innovation

The innovation of the proposed project is a high-capacity turbo-Brayton cryocooler for thermal management of VASIMR electromagnets. The cryocooler design will be derived from the space-qualified unit that was developed by Creare and installed on the Hubble Space Telescope. Turbo-Brayton cryocoolers are ideal for space applications because they are lightweight, compact, efficient, highly reliable and have long maintenance-free lifetimes (>10 years). Furthermore, the technology scales well to high cooling capacities and is inherently simple to integrate with multiple cooling objects; attributes that are particularly beneficial for VASIMR systems. Successful completion of this project will enable manned space exploration missions.



High-Capacity Turbo-Brayton Cryocooler Integrated with VASIMR Electromagnets

Phase I Technical Objectives and Work Plan

Define Requirements of the Thermal Management System. Define thermal loads and temperatures for cooling electromagnets.

Design a Robust Thermal Isolation System for the Electromagnets. Design a low heat-leak structure to support the electromagnets during space launch.

Design Components in Thermal Management System. Develop preliminary designs of the thermal management systems. Estimate size, mass, input power and heat rejection requirements and compare to alternative systems.

Program Plan

Phase I—Develop designs for multistage, high-capacity cryocoolers for VASIMR systems.

Phase II—Develop and demonstrate the performance of a prototypical thermal management system.

Phase III – Fabricate and deliver Engineering Model (EM) cryocoolers for test and evaluation. Transition to flight units through licensing/teaming.

NASA Applications

Space applications include cooling for HTS magnets for electric propulsion, and observation platforms requiring large arrays of infrared and X-ray detectors; and cooling for cryogen storage for planetary and extraterrestrial exploration missions, extended-life orbital transfer vehicles, long-term geosynchronous missions, in-space propellant depots and extraterrestrial bases. Terrestrial applications include cooling for spaceport cryogen storage and cryogen transportation systems.

Non-NASA Applications

Non-NASA commercial applications include cooling for laboratory- and industrial-scale gas separation, liquefaction, cryogen storage and cryogen transportation systems; high-temperature superconducting magnets in motors and magnetic resonance imaging systems; and commercial orbital transfer vehicles and satellites.

Contact

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